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IS 8904 (1997): Anthrarufin [PCD 9: Organic Chemicals  
Alcohols and Allied Products and Dye Intermediates]

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*Indian Standard*  
ANTHRARUFIN — SPECIFICATION  
( *First Revision* )

ICS 71.080.80

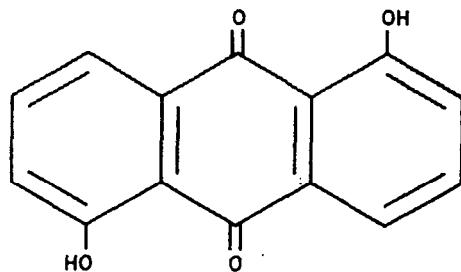
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## FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Dye Intermediates Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Anthrarufin (  $C_{14}H_8O_4$  ), chemically described as 1,5-dihydroxyanthraquinone, is an important dye intermediate used in the manufacture of disperse dyes. It is represented by the following structural formula:



ANTHARUFIN  
( Molecular Mass 240.2 )  
CAS Registry No. | 117-12-4 |

This standard was first published in 1978. The committee responsible for the preparation of this standard decided to update it in the light of experience gained. In this revision, the requirements for impurities that is 1,8 dihydroxyanthraquinone and 1-hydroxyanthraquinone have been stipulated. An alternate High Pressure Liquid Chromatography ( HPLC ) method for the determination of 1,5-dihydroxyanthraquinone content and its impurities has also been incorporated in this standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*  
**ANTHRARUFIN — SPECIFICATION**  
*(First Revision)*

### 1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for anthrarufin.

### 2 NORMATIVE REFERENCES

The following Indian Standards contain provisions, which through reference in this text, constitute the provisions of the standard. At the time of publication the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
1070 : 1992	Reagent grade water ( <i>third revision</i> )
2552 : 1989	Steel drums (galvanized and ungalvanized) ( <i>third revision</i> )
5299 : 1969	Methods of sampling and tests of dye intermediates

### 3 REQUIREMENTS

#### 3.1 Description

The material shall be in the form of a dull yellow powder.

**Table 1 Requirements for Anthrarufin**  
*(Clauses 3.2, 5.3.1, 5.3.2 and 6.1)*

<i>Sl No.</i>	<i>Characteristic,</i>	<i>Requirement</i>	<i>Method of Test, Ref to</i>
(1)	(2)	(3)	(4)
i)	1, 5-Dihydroxyanthraquinone, percent by mass, <i>Min</i>	88.0	Annex A
ii)	1, 8-Dihydroxyanthraquinone, percent by mass, <i>Mix</i>	2.0	Annex A
iii)	1-Hydroxyanthraquinone, percent by mass, <i>Max</i>	3.0	Annex A
iv)	Melting point	Shall melt within the range of 3°C between the limits 275°C to 280°C	8 of IS 5299
v)	Moisture, percent by mass, <i>Max</i>	0.5	9.3 of IS 5299
vi)	Sulphated ash, percent by mass, <i>Max</i>	2.0	11.2 of IS 5299

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## 5 SAMPLING

**5.1** Representative samples of the material shall be drawn as prescribed in 3 of IS 5299.

### 5.2 Number of Tests

**5.2.1** Tests for the determination of 1,5-dihydroxyanthraquinone, 1,8-dihydroxyanthraquinone and 1-hydroxyanthraquinone shall be conducted on each of the individual samples.

**5.2.2** Tests for the determination of remaining characteristics, namely, description, melting point, moisture and sulphated ash shall be conducted on the composite sample.

### 5.3 Criteria for Conformity

#### 5.3.1 For Individual Samples

The lot shall be declared as conforming to the

requirement of 1,5-dihydroxyanthraquinone, 1,8-dihydroxyanthraquinone and 1-hydroxyanthraquinone if each of the individual test results satisfies the relevant requirements given in Table 1.

#### 5.3.2 For Composite Sample

For declaring the conformity of the lot to the requirements of all other characteristics (see 5.2.2) tested on the composite sample, the test results for each of the characteristics shall satisfy the relevant requirements given in 3.1 and Table 1.

## 6 TEST METHODS

**6.1** Tests shall be carried out according to the methods referred in col 4 of Table 1.

### 6.2 Quality of Reagents

Unless specified otherwise, pure chemicals and distilled water (see IS 1070) shall be employed in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

## ANNEX A

[ *Table 1, Sl No. (i), (ii) and (iii)* ]

## DETERMINATION OF 1,5-DIHYDROXYANTHRAQUINONE AND ITS IMPURITIES

### A-1 GENERAL

Two methods, namely Method A 'Column chromatography' and Method B 'High pressure liquid chromatography (HPLC)' have been prescribed for the determination of 1,5-dihydroxyanthraquinone and its impurities. Any of these methods can be used on routine basis. However in the event of dispute, HPLC method shall be treated as referee method.

### A-2 METHOD A

#### A-2.1 Outline of the Method

The purity of the material is estimated by the chromatographic method. 1,5-Dihydroxyanthraquinone is separated from its impurities chromatographically and estimated quantitatively by spectrophotometer.

#### A-2.2 Reagents

##### A-2.2.1 Sodium Carbonate

Sodium carbonate of the following specifications shall be used as it is found to be suitable for chromatographic

analysis to obtain effective separation:

	<i>Fineness</i>	<i>Percentage</i>
Retained on 150-micron IS sieve		0.0
Retained on 75-microns IS sieve		30 to 45
Passing through 53-micron IS sieve		45 to 50

##### A-2.2.1.1 Activation

Sodium carbonate of the above fineness should be activated before use by drying overnight at 200°C.

##### A-2.2.2 Acetone

Pure, dried over fused calcium chloride, filtered and distilled before use. Determine its water content by the Karl Fischer method.

##### A-2.2.3 Solvent Mixture A

Pure, distilled acetone adjusted to contain 0.5 percent water (m/v).

##### A-2.2.4 Solvent Mixture B

Pure, distilled acetone adjusted to contain 2.0 percent water (m/v).

**A-2.2.5 Solvent Mixture C**

Pure, distilled acetone adjusted to contain 3.0 percent water (m/v).

**A-2.2.6 Toluene**

Pure, dried over fused calcium chloride, filtered and distilled before use. Portion distilling between 110°C and 111°C shall be collected for use. It shall be clear and colourless.

**A-2.2.7 Chromatographically Pure 1,5-Dihydroxyanthraquinone**

Dissolve 200 mg of 1,5-dihydroxyanthraquinone in 200 ml of toluene. Boil and reflux for 15 minutes. Cool to room temperature, transfer to 250 ml volumetric flask and make up to the mark with toluene. Mix well and call it solution X.

**A-2.2.7.1** Transfer the solution X gradually to the chromatographic column. When all the solution loaded has entered the column and the glass wool at the top of the column is just dry, add small quantities of solvent mixture A without disturbing the surface until the bands start moving down the column. Continue elution with solvent mixture A until there is distinct separation of bands which will be in the following order (from bottom to top):

- Small yellow band of 1-hydroxyanthraquinone.
- Main orange band of 1,5-dihydroxyanthraquinone.
- Pink band of 1,8-dihydroxyanthraquinone.
- Purple band at the top of the column.

Elute the small yellow band of 1-hydroxyanthraquinone with solvent mixture A. After the small yellow band is completely eluted, change the eluent to solvent mixture B, when the main orange band will move down the column. Collect this elute which represents the pure 1,5-dihydroxyanthraquinone. A battery of five to six tubes to be kept in operation for collecting a sizable quantity of the material. Filter through filter paper to remove any stray products of the adsorbent. Concentrate the total quantity of elute of 1,5-dihydroxyanthraquinone by distillation until crystallization occurs on cooling to room temperature. Filter on a sintered glass crucible of porosity G4 and wash, first with hot water and then with cold water. Suck dry and finally dry in oven at 100°C.

In order to check the purity, dissolve 10 mg (accurately weighed) in 10 ml of toluene and pass the cooled solution through a chromatographic column eluting with solvent mixture B as necessary. Collect the band carefully (only one band should appear) and determine

its optical density at 428 nm. Make up a solution of purified crystals using the same proportion of crystals to solvent. Determine its optical density in the same way. A difference in two figures for optical density amounting to more than 0.003 indicates the presence of an impurity. The chromatographic purification shall in such a case to be repeated until this check test is satisfied.

**A-2.2.8 1-Hydroxyanthraquinone**

Pure (100 percent on dry basis).

**A-2.2.9 1,8-Dihydroxyanthraquinone**

Pure (100 percent on dry basis).

**A-2.2.10 Glacial Acetic Acid****A-2.3 Apparatus****A-2.3.1 Chromatographic Column**

A glass tube 40 cm long and having 1.5 cm internal diameter, joined with a 50-ml thistle funnel at the upper end and fitted with a stopcock at the lower end, is set up vertically, such that the percolation passing through the tube can be collected conveniently in a 250-ml conical flask. Place a glass-wool plug in the tube and press it to the bottom of the tube by means of a glass rod flattened latitudinally at the end. Place a disc of filter paper cut to the approximate internal diameter of the chromatographic tube on the top of the glass-wool.

**A-2.3.1.1** Prepare a slurry of sodium carbonate in solvent mixture (A) and pour it into the chromatographic tube. Wash down the sides of the tube and pack the column by lightly tapping the tube. Place first a disc of filter paper and then a glass-wool plug at the top of the column. Care should be taken to see that at least a 2 cm layer of the solvent remains always on top of the column. On no account shall the column be left dry. In the event of the latter happening, reslurry the sodium carbonate in the tube and repack.

**A-2.3.2 Vacuum Oven****A-2.3.3 Spectrophotometer**

Capable of taking reading at 407 nm and 428 nm.

**A-2.4 Standard Calibration Graph**

**A-2.4.1** Prepare a number of standard solutions of the chromatographically pure 1,5-dihydroxyanthraquinone in solvent mixture (B) varying in concentrations from 0.6 mg/100 ml to 2.0 mg/100 ml with a difference of 0.2 mg/100 ml between two successive concentrations. Before making up the volume to 100 ml add 4 ml of glacial acetic acid in each flask.

**A-2.4.2** Prepare a calibration graph of 1-hydroxyanthraquinone in an identical way as **A-2.4.1** using solvent mixture A.

**A-2.4.3** Prepare a calibration graph of 1,8-dihydroxyanthraquinone in an identical way as **A-2.4.1** using solvent mixture C.

**A-2.4.4** Take readings for optical density or percentage transmittance for the solution of various concentrations (see **A-2.4.1**) at a wavelength of 428 nm (see Notes) using specially matched cells specified for the particular spectrophotometer used. The temperature of the solutions immediately before and after measurements shall be  $27 \pm 2^\circ\text{C}$ .

Take readings for optical density or percentage transmittance for the solution of various concentrations (see **A-2.4.2**) at a wavelength of 407 nm (see Notes) using specially matched cells as above.

Also take readings for optical density or percentage transmittance for the solutions of various concentrations (see **A-2.4.3**) at a wavelength of 428 nm (see Notes) using specially matched cells as above.

#### NOTES

1 Maximum absorption (or minimum transmittance) has been at a wavelength of 407 nm and 428 nm by standard instruments. However, this may need checking with the particular instrument to be used. Several readings for absorbance using solutions of varying concentrations are taken at different wavelengths and that for maximum absorption determined from the graph.

2 The standard calibration curve and the spectrophotometer shall be checked for accuracy from time to time.

**A-2.4.5** When instrument is calibrated in percentage transmittance only, the optical density may be read out from a standard table. Plot the calibration curve of concentration (in mg/100 ml) against optical density for 1,5-dihydroxyanthraquinone, 1-hydroxyanthraquinone and 1,8-dihydroxyanthraquinone.

#### A-2.5 Procedure

**A-2.5.1** Weigh accurately about 50 mg of the dry pulverized sample of the material in a 250-ml conical flask. Add about 200 ml of toluene and reflux for about 15 minutes (using a condenser) to effect complete solution. Cool to room temperature by keeping in water-bath. Transfer the solution to a dry 250-ml volumetric flask. Rinse the conical flask with small amounts of toluene and transfer the rinsings also to the volumetric flask. Make up to the mark with toluene and mix the solution (1) well.

**A-2.5.2** Prepare a solvent-soaked adsorption column of sodium carbonate using a chromatographic tube

40 cm in length and 1.5 cm internal diameter. Standardized sodium carbonate suitable for chromatographic analysis is used as adsorbent and solvent mixture (A) as the solvent. Pack the column (see **A-2.3.1**).

**A-2.5.3** Load 10 ml of the solution (1) of 1,5-dihydroxyanthraquinone. When all the solution has entered the column and glass-wool at the top of the column is just dry. Add a small quantity of solvent mixture (A). Go on adding the solvent in small lots until the glass-wool on the top of the column is colourless and all the coloured solution is washed into the column. Now add more solvent mixture (A) carefully without disturbing the surface of the column and continue further addition of solvent mixture (A).

Collect the small yellow band of 1-hydroxyanthraquinone in 100 ml volumetric flask containing 4.0 ml of glacial acetic acid. Make up to mark with solvent mixture (A). Mix well. Call this solution (2).

**A-2.5.4** Now change the eluent to solvent mixture B, the main orange band of 1,5-dihydroxyanthraquinone, will start moving down the column. Collect this elute in 100-ml volumetric flask containing 4 ml of glacial acetic acid. When elution is complete, make up to mark with solvent mixture B. Mix well and call this solution (3).

Change the eluent to solvent mixture C. The pink band of 1,8-dihydroxyanthraquinone will move down the column. Collect this elute in 100-ml volumetric flask containing 4 ml of glacial acetic acid. Make up to mark with solvent mixture C. Mix well. Call this solution (4).

Adjust the wavelength of maximum absorption at 407 nm for solution (2) and 428 nm for solution (3) and (4). Adjust the instrument in such a way that the transmittance through the blank solution is recorded at 100 percent reading after inserting the cell with the blank solution (solvent mixture A, B and C respectively). Now replace the cell with solution (2), (3) and (4) of the sample and read the percentage transmittance. Referring to the standard tables for conversion of transmittance to optical density read out concentration C against optical density from standard calibration graph in terms of mg/100 ml of the final dilute solution (2), (3) and (4).

#### A-2.6 Calculation

i) 1-Hydroxyanthraquinone.  $A \times 2.500$   
percent by mass  $\quad \quad \quad M$

where

$A =$  mass in mg of 1-hydroxyanthraquinone contained in 100 ml of solution (2)

$M$  = mass in mg of the material under test.

ii) 1,5-Dihydroxyanthraquinone,  $\frac{B \times 2500}{M}$  percent by mass

where

$B$  = mass in mg of 1,5-dihydroxyanthraquinone contained in 100 ml of solution (3).

$M$  = mass in mg of the material under test.

iii) 1,8-Dihydroxyanthraquinone,  $\frac{C \times 2500}{M}$  percent by mass

where

$C$  = mass in mg of 1,8-dihydroxyanthraquinone contained in 100 ml of solution (4).

$M$  = mass in mg of the material under test.

## A-3 METHOD B

### A-3.1 Outline of the Method

A-3.1.1 Assay and impurities of 1,5-dihydroxyanthraquinone are estimated by High Pressure Liquid Chromatographic method.

### A-3.2 Reagents

#### A-3.2.1 1,5-Dihydroxyanthraquinone

Pure (100 percent on dry basis).

#### A-3.2.2 1,8-Dihydroxyanthraquinone

Pure (100 percent on dry basis).

#### A-3.2.3 1-Hydroxyanthraquinone

Pure (100 percent on dry basis).

#### A-3.2.4 Tetrahydrofuran

Spectroscopy grade.

#### A-3.2.5 Acetic Acid

Extra pure.

#### A-3.2.6 Distilled Water

### A-3.3 Apparatus

#### A-3.3.1 High Pressure Liquid Chromatograph

Any suitable chromatograph with a reverse phase column. Typical parameters of waters HPLC is given below:

Column — u-Bondapak C<sub>18</sub>

Temperature — 25°C

Wavelength — 254 nm

Flow rate — 1.2 ml/Min.

Attenuator — 0.1

Chart speed — 10 mm/Min.

Load on column — 5.0 µl

Mobile phase —

Tetrahydrofuran : Distilled water : Acetic acid

50 : 50 : 1.5

### A-3.3.2 'A' Grade Volumetric Flask

### A-3.4 Procedure

#### A-3.4.1 Preparation of Sample Solution

A-3.4.1.1 Weigh accurately 0.05 g of well mixed (previously ground and dried) sample and transfer to 100 ml standard volumetric flask using 80 ml of Tetrahydrofuran (A-3.2.4). Dissolve it in hot water bath. Cool to room temperature. Dilute to mark using Tetrahydrofuran and mix well. Call this solution 'S'.

Pipette 10 ml of solution 'S' in 100 ml standard volumetric flask and dilute to mark using Tetrahydrofuran. Mix well. Call this solution 'S1'.

#### A-3.4.2 Preparation of Standard Solution

##### A-3.4.2.1 1,5-Dihydroxyanthraquinone Pure.

Weigh accurately 0.05 g of pure 1,5-dihydroxyanthraquinone (previously dried) and transfer to 100 ml standard volumetric flask using 80 ml of tetrahydrofuran (A-3.2.4). Dissolve it in hot water bath. Cool to room temperature. Dilute to mark using tetrahydrofuran and mix well. Call this solution 'A'.

Pipette 10 ml of solution 'A' in 100 ml standard volumetric flask and dilute to mark using tetrahydrofuran. Mix well. Call this solution 'A1'.

##### A-3.4.2.2 1,8-Dihydroxyanthraquinone Pure.

Weigh accurately 0.05 g of pure 1,8-dihydroxyanthraquinone (previously dried) and transfer to 100 ml standard volumetric flask using 80 ml of tetrahydrofuran. Prepare a solution 'B1' in an identical way as prepared in A-3.4.2.1.

##### A-3.4.2.3 1-Hydroxyanthraquinone Pure.

Weigh accurately 0.05 g of pure 1-hydroxyanthraquinone (previously dried) and transfer to 100 ml standard volumetric flask using 80 ml of tetrahydrofuran. Prepare a solution 'C' and 'C1' in an identical way as prepared in A-3.4.2.1

**A-3.4.3 Determination of 1,8-Dihydroxyanthraquinone and Impurities as 1,5 Dihydroxyanthraquinone and 1-Hydroxyanthraquinone**

**A-3.4.3.1** When steady base line is obtained, inject

5.0  $\mu$ l of each standard solution A1, B1 and C1. Also inject 5.0  $\mu$ l of sample solution S1.

Measure height and base width of the peak and calculate. A typical chromatogram is shown in Fig. 1.

**A-3.4.3.2 Calculation**

	$\text{Concentration of standard} \times \text{Area of peak in the sample} \times \text{Strength of standard}$
1,5-Dihydroxyanthraquinone, percent by mass	$\text{Concentration of sample} \times \text{Area of peak of standard}$
1,8-Dihydroxyanthraquinone, percent by mass	Same as above
1-Hydroxyanthraquinone, percent by mass	Same as above

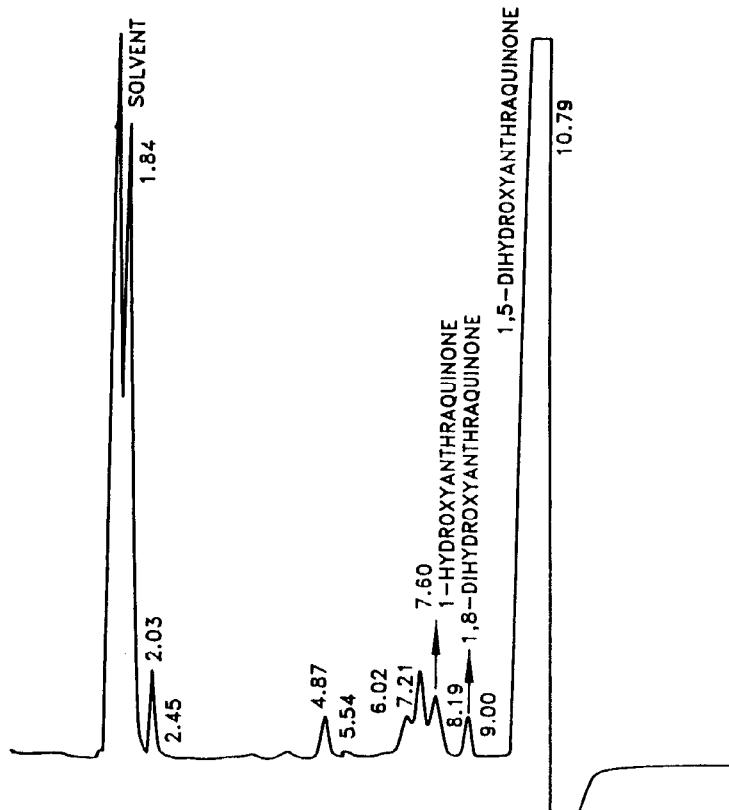


FIG. 1 A TYPICAL HIGH PRESSURE LIQUID CHROMATOGRAM FOR ANTHRARUFIN ( 1,5 DIHYDROXYANTHRAQUINONE )

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#### Amendments Issued Since Publication

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